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UNITED STATES PUBLIC HEALTH SERVICE

RUPERT BLUE, SURGEON GENERAL

# HEIGHTS AND WEIGHTS OF CHILDREN

CLASSIFICATION, BY AGE AND BY SANITATION, OF  
1,652 WHITE SCHOOL CHILDREN (771 BOYS,  
881 GIRLS) IN THE CITY OF X

BY

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AND

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*Assistant Surgeon, United States Public Health Service*

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## HEIGHTS AND WEIGHTS OF CHILDREN.

CLASSIFICATION, BY AGE AND BY SANITATION, OF 1,652 WHITE SCHOOL CHILDREN  
(771 BOYS, 881 GIRLS) IN THE CITY OF X.<sup>1</sup>

By C. W. STILES, Professor of Zoology, and GEORGE A. WHEELER, Assistant Surgeon, United States  
Public Health Service.

Of the children here considered, the minority lived at homes provided with privies (Group P), the major portion at homes provided with sewers but not with privies (Group S).

In two former articles <sup>1</sup> it has been shown that if these children are classified into these sanitary groups and compared as to their unconscious coprophagia and their school-grade advancement, the comparisons are more favorable to Group S than to Group P.

The question arises whether these same children, when classified into the same groups (P and S) and compared as to their heights and weights, show any differences in the two sanitary groups, and if so, what these differences are.

This inquiry is one purely as to fact. The explanation of the facts is a very complicated matter, involving questions of sociology, physiology, pathology, heredity, etc.

Most of the studies on children have been conducted in localities other than the Southern States. On this account, when an author desires to study any given condition in southern children he is usually obliged to use standards based upon children studied in the North or in Europe. When comparing cases of infection, such comparison is likely to be misleading, and on this account an attempt is made here to add a short contribution to the standardization of southern children that may be used in future work.

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<sup>1</sup> For other articles on the city of X, see Public Health Reports, 1915, as follows: Difficulties in obtaining ages, v. 30 (5), Jan. 29, pp. 310-311; Zooparasitic intestinal infections, v. 30 (27), July 2, pp. 1991-2002; School grades, v. 30 (28), July 9, 2060-2067; Tobacco and snuff, v. 30 (40), Oct. 1, 1915, pp. 2926-2928.

Reprint from the P. H. R., vol. 30, No. 41, Oct. 8, 1915.

TABLE 1.—Average, minimum, and maximum heights and weights of 765 to 771 white boys, 6 to 17.75 years old, inclusive, of the city of X, summarized by total year periods and by sanitary groups.

P=children from homes provided with a privy; S=children from homes with sewer connection, but without a privy; U=home sanitation unknown; T=total of P, S, and U.]

Age.	Height, in inches.								Weight, in pounds.			
	Standing, 771 boys.				Sitting, 765 boys.				768 boys.			
	Number of pupils.	Average.	Minimum.	Maximum.	Number of pupils.	Average.	Minimum.	Maximum.	Number of pupils.	Average.	Minimum.	Maximum.
6 S.....	26	44.20	35.75	56.00	24	24.56	23.25	26.00	26	43.43	30.25	58.25
6 P.....	7	44.21	42.00	48.00	6	25.00	24.00	26.50	6	48.08	43.50	55.75
6 U.....	1	48.58	48.50	48.50	1	24.50	24.50	24.50	1	50.25	50.25	50.25
T.....	34	44.33	35.75	56.00	31	24.65	23.25	26.50	33	44.50	30.25	58.25
7 S.....	58	47.05	34.50	55.50	57	25.65	23.00	29.25	57	50.10	38.25	64.00
7 P.....	15	47.13	43.50	56.25	15	25.48	23.75	31.00	15	50.03	42.50	61.50
7 U.....	3	46.58	43.50	48.25	3	25.42	25.00	26.00	3	52.67	46.00	61.00
T.....	76	47.05	34.50	56.25	75	25.61	23.00	31.00	75	50.19	38.25	64.00
8 S.....	62	48.40	43.00	53.50	62	26.12	23.50	29.50	62	54.42	38.25	74.00
8 P.....	15	49.35	43.50	57.00	15	26.47	24.00	28.50	15	54.63	44.75	70.00
8 U.....	3	46.92	43.50	52.25	3	25.33	23.50	28.25	3	50.67	40.00	62.00
T.....	80	48.52	43.00	57.00	80	26.16	23.50	29.50	80	54.32	38.25	74.00
9 S.....	76	50.24	45.25	58.25	76	26.87	23.75	30.25	76	57.56	38.25	89.00
9 P.....	12	49.52	47.00	52.00	12	26.85	23.25	27.75	12	57.95	52.50	63.00
9 U.....	5	50.25	46.50	54.00	5	27.30	24.50	29.00	5	59.90	44.00	73.00
T.....	93	50.15	45.25	58.25	93	26.89	23.75	30.25	93	57.74	38.25	89.00
10 S.....	80	52.28	45.00	57.50	80	27.93	22.50	38.50	79	64.93	49.00	110.50
10 P.....	13	51.69	48.75	54.00	12	27.65	24.75	29.25	12	59.92	49.00	72.50
10 U.....	9	52.36	48.00	59.25	9	27.44	25.00	31.00	9	64.92	49.50	85.50
T.....	102	52.22	45.00	59.25	101	27.86	22.50	38.50	100	64.32	49.00	110.50
11 S.....	58	53.74	49.75	64.00	58	27.98	24.00	33.50	59	69.67	49.00	105.00
11 P.....	20	53.47	50.50	57.75	20	28.21	27.00	30.50	20	68.02	59.00	81.00
11 U.....	5	53.75	51.00	55.75	5	27.90	26.00	29.25	5	72.75	66.25	86.00
T.....	83	53.68	49.75	64.00	83	28.04	24.00	33.50	84	69.46	49.00	105.00
12 S.....	53	55.81	50.50	62.00	53	28.86	26.00	32.50	53	77.76	57.75	127.50
12 P.....	14	56.00	49.75	62.00	13	29.10	25.75	33.25	13	75.34	55.00	104.00
12 U.....	9	56.94	52.00	65.50	9	30.22	27.00	34.50	9	96.02	59.50	126.50
T.....	76	55.98	49.75	65.50	75	29.06	25.75	34.50	75	79.53	55.00	127.50
13 S.....	57	58.12	49.00	67.75	57	30.46	27.50	34.50	57	85.93	61.25	123.50
13 P.....	9	57.69	53.50	61.00	9	30.92	29.00	33.00	9	86.50	69.00	97.00
13 U.....	3	63.33	59.00	68.75	3	32.67	29.25	35.75	3	114.08	81.00	142.00
T.....	69	58.29	49.00	68.75	69	30.62	27.50	35.75	69	87.23	61.25	142.00
14 S.....	38	59.64	53.25	67.00	38	31.12	27.50	34.00	38	92.57	67.50	127.50
14 P.....	4	59.81	53.75	65.50	4	31.25	28.00	34.00	4	96.31	68.50	124.50
14 U.....	8	60.59	57.25	67.50	8	31.22	29.00	36.00	8	96.75	71.50	154.00
T.....	50	59.81	53.25	67.50	50	31.15	27.50	36.00	50	93.54	67.50	154.00
15 S.....	41	62.79	54.00	70.25	41	32.70	27.50	36.00	41	110.45	78.50	164.00
15 P.....	4	59.88	56.00	65.00	4	31.50	28.25	34.25	4	93.81	79.00	111.75
15 U.....	10	63.08	57.75	69.00	10	32.25	30.00	35.75	10	109.45	80.00	166.75
T.....	55	62.63	54.00	70.25	55	32.53	27.50	36.00	55	109.06	78.50	166.75
16 S.....	31	64.85	57.00	69.50	31	33.80	29.50	43.50	32	110.35	77.50	142.75
16 P.....	2	63.88	65.75	65.25	2	33.00	32.00	34.00	2	129.37	105.00	115.00
16 U.....	3	61.00	59.00	64.00	3	31.50	30.25	33.25	3	97.00	88.00	105.50
T.....	36	64.48	57.00	69.50	36	33.56	29.50	43.50	37	109.25	77.50	142.75
17 S.....	13	66.60	62.75	70.00	13	34.75	32.00	39.50	13	125.27	92.50	166.00
17 P.....	2	66.38	65.75	67.00	2	35.00	34.50	35.50	2	129.37	121.00	137.75
17 U.....	2	65.50	63.50	67.50	2	34.88	34.00	35.75	2	131.75	125.00	138.50
T.....	17	66.44	62.75	70.00	17	34.79	32.00	39.50	17	126.51	92.50	166.00

TABLE 2.—Average, minimum, and maximum heights and weights of 877 to 881 white girls, 6 to 17.75 years old, inclusive, of the city of X, summarized by total year periods and by sanitary groups.

[P=children from homes provided with a privy; S=children from homes with sewer connection but without a privy; U=home sanitation unknown; T=total of P, S, and U.]

Age.	Height in inches.								Weight in pounds.			
	Standing, 881 girls.				Sitting, 879 girls.				877 girls.			
	Number of pupils.	Average.	Minimum.	Maximum.	Number of pupils.	Average.	Minimum.	Maximum.	Number of pupils.	Average.	Minimum.	Maximum.
6 S.....	31	45.22	42.00	58.50	31	24.50	22.00	27.50	30	44.88	35.50	62.50
6 P.....	6	45.50	42.00	49.00	5	23.45	23.00	24.25	5	45.35	39.25	48.75
6 U.....	1	43.50	43.50	43.50	1	24.00	24.00	24.00	1	43.50	43.50	43.50
T.....	38	45.22	42.00	58.50	37	24.34	22.00	27.50	36	44.90	35.50	62.50
7 S.....	44	46.79	40.75	56.00	44	25.35	22.25	28.00	44	48.85	38.00	70.75
7 P.....	15	46.58	43.00	49.50	15	25.40	22.25	29.25	15	51.30	43.25	65.00
7 U.....	4	45.44	43.50	48.00	4	24.57	23.25	26.25	4	44.31	43.75	44.50
T.....	63	46.80	40.75	56.00	63	25.31	22.25	29.25	63	49.15	38.00	70.75
8 S.....	50	48.81	44.00	57.00	50	26.00	22.50	29.25	49	53.34	40.25	78.25
8 P.....	13	47.53	45.00	50.25	13	25.35	24.00	27.00	13	51.30	43.25	57.00
8 U.....	2	48.88	48.25	49.50	2	27.00	26.50	27.50	2	55.37	54.75	56.00
T.....	65	48.52	44.00	57.00	65	25.90	22.50	29.25	64	52.62	40.25	78.25
9 S.....	54	50.36	46.00	56.50	54	26.67	24.00	29.00	54	58.47	43.00	79.50
9 P.....	25	48.75	47.00	58.00	25	26.90	25.00	30.00	25	57.04	42.00	79.50
9 U.....	4	48.88	48.25	49.50	4	25.50	25.00	26.25	4	62.50	50.50	86.00
T.....	83	49.81	46.00	58.00	83	26.68	24.00	30.00	83	58.23	42.00	86.00
10 S.....	74	52.05	48.00	59.25	73	28.05	23.75	32.00	74	64.33	46.00	100.25
10 P.....	21	51.54	48.00	54.75	21	27.64	26.00	29.50	21	62.78	45.50	92.25
10 U.....	3	51.92	49.50	55.00	3	27.42	26.00	28.75	3	64.08	55.00	69.25
T.....	98	51.93	48.00	59.25	97	27.95	23.75	32.00	98	63.99	45.50	100.25
11 S.....	63	54.34	42.50	61.25	63	28.61	23.50	32.50	62	70.60	49.50	113.00
11 P.....	21	52.75	48.25	58.75	21	27.92	25.50	31.25	21	69.46	53.50	94.50
11 U.....	3	55.33	53.00	58.50	3	29.17	28.00	30.50	3	98.17	66.00	157.00
T.....	87	53.99	42.50	61.25	87	28.46	23.50	32.50	86	71.28	49.50	157.00
12 S.....	62	56.67	50.75	62.75	62	29.75	26.00	41.00	61	82.47	56.75	150.50
12 P.....	17	56.35	49.50	57.25	17	29.82	26.25	32.00	18	89.94	49.00	156.00
12 U.....	4	56.56	53.50	58.25	4	29.69	29.00	30.25	4	83.87	66.50	103.00
T.....	83	56.60	49.50	62.75	83	29.77	26.00	41.00	83	84.16	49.00	156.00
13 S.....	74	60.14	51.00	68.00	74	31.78	28.25	35.75	74	96.50	60.50	154.00
13 P.....	16	59.09	54.75	62.00	16	30.94	26.50	33.00	16	91.20	63.75	115.00
13 U.....	2	60.25	58.50	62.00	2	31.13	30.25	32.00	2	103.25	83.50	121.00
T.....	92	59.96	51.00	68.00	92	31.62	26.50	35.75	92	95.72	60.50	154.00
14 S.....	65	60.12	53.75	66.00	65	31.58	26.00	36.50	65	98.30	66.50	139.75
14 P.....	20	60.56	54.00	68.50	20	31.88	30.00	34.25	20	95.39	67.50	130.00
14 U.....	7	61.21	57.50	65.75	7	32.03	29.50	36.00	7	111.75	77.50	192.25
T.....	92	60.29	53.75	68.50	92	31.67	26.00	36.50	92	98.69	66.50	192.25
15 S.....	58	61.77	53.50	66.50	58	32.66	27.25	35.00	58	108.64	83.00	146.00
15 P.....	15	61.15	56.00	63.50	15	32.52	30.75	34.00	15	107.45	89.00	179.50
15 U.....	1	66.25	66.25	66.25	1	35.00	35.00	35.00	1	137.50	137.50	137.50
T.....	74	61.71	53.50	66.50	74	32.81	27.25	35.00	74	108.79	83.00	179.50
16 S.....	62	62.50	56.75	68.50	62	33.08	25.50	46.00	62	112.53	82.75	141.00
16 P.....	6	62.12	59.25	64.50	6	32.50	29.00	33.75	6	111.58	92.00	144.25
16 U.....	5	61.20	56.25	64.50	5	33.20	31.50	35.00	5	106.15	98.50	122.50
T.....	73	62.38	56.25	68.50	73	33.04	25.50	46.00	73	112.01	82.75	144.25
17 S.....	29	62.81	56.75	69.50	29	33.68	31.25	36.50	29	116.28	82.50	157.25
17 P.....	2	62.88	62.00	63.75	2	33.00	33.00	33.00	2	111.00	110.00	112.00
17 U.....	2	62.13	60.00	64.25	2	32.25	32.50	34.00	2	108.50	101.00	116.00
T.....	33	62.77	56.75	69.50	33	33.62	31.25	36.50	33	115.49	82.50	157.25

*Age groups.*—The tests were begun on January 7 and continued every school day until April 6, inclusive. On January 7 all of the available white school children in the city whose birthday was January 7, April 7, July 7, or October 7 were brought to the high school assembly hall and were given certain mental and physical tests; on each succeeding day for three months the same plan was followed except that children whose birthday anniversary came on Saturday were tested on Friday and those whose birthday anniversary came on Sunday were tested on Monday; further, also, some slight irregularities of date were introduced because of school examination days, temporary absence from school, and unusually stormy weather. These variations, rarely, if ever, exceeded 72 hours. Accordingly, the children automatically fell into quarter-year groups, and all of the children of a given group were of the same age to a day. For instance, all 10-year-old children were 10 years flat, 10.25, 10.50, or 10.75 years old to the day, and the tests agree to the day or almost to the day. This plan naturally gave very exact groups, but in some instances it reduced the individuals of certain groups to small numbers.

A large number of the children had to be rejected from the final summaries because it was impossible to obtain their birthday<sup>1</sup> and birth year, hence it was impossible to determine their exact age group.

Heights were taken in stocking feet (without shoes) to the nearest  $\frac{1}{4}$  inch. Weights were taken with clothes, but without coats or shoes.

#### White Boys.

##### STANDING HEIGHT.

Of 1,189 white school boys, 6 years flat to 17.75 years old, inclusive, data in standing height are available for 771; 593 of these belong to Group S (from homes with sewers but without privies), 117 to Group P (from homes with privies), and 61 to Group U (sanitation unknown).

Taking the totals for each year age (as 6 flat to 6.75=6 years old, etc.) the minimum, maximum, and average heights may be seen from Table 1. If these results are plotted on a diagram (chart 1), it is seen that there is a fairly uniform increase in standing height, year by year, but there is a distinct decrease of the increase at 11, and a much less distinct decrease of the increase at 14.

In comparing Groups P and S the following results are obtained:

*Average standing height for total year periods.*—In 7 total year periods (9, 10, 11, 13, 15, 16, and 17 years) the boys of Group S

<sup>1</sup> Difficulties in Obtaining Ages. Public Health Reports, vol. 30, No. 5, Jan. 29, 1915, pp. 310-311.



had an average height greater than that shown in the corresponding boys of Group P.

In 5 total year periods (6, 7, 8, 12, and 14 years) the boys of Group P had an average height greater than that shown in the corresponding boys of Group S.

*Average standing height for quarter-year periods.*—If the quarter-year periods are compared, the units are reduced to very small numbers in some groups, hence the element of chance is greatly increased, but the results are as follows:

In 24 quarter-year periods, the boys of Group S had an average height greater than that of the corresponding boys of Group P, while in 14 periods the boys of Group P had a greater average height than the corresponding boys of Group S; in one period they were equal for S and P; and in 9 periods no comparison could be made as there was no boy of Group P for these ages.

#### SITTING HEIGHT.

Sitting height was obtained for 765 boys, of whom 590 belonged to Group S, 114 to Group P, and 61 to Group U.

The curve (chart 1) for sitting heights shows a very marked decrease of the increase at 11, corresponding to, but more marked than, the decrease of the increase in the standing height for the same period. There is also a clear decrease of the increase at 14, corresponding to, but slightly more marked than, the decrease of the increase in the standing height for the same period. From 14 to 17 the increase is fairly uniform, and almost parallel to the standing height.

*Average sitting height for total year periods.*—In 5 total year periods (namely, 7, 9, 10, 15, and 16 years) the average sitting height of Group S excelled that of Group P, and in 7 total year periods (namely, 6, 8, 11, 12, 13, 14, and 17 years) the average in Group P excelled that of Group S.

In 4 total year periods (9, 10, 15, and 16 years) Group S excelled both in sitting height and in standing height, while in 4 other year periods (6, 8, 12, and 14 years) Group P excelled in both sitting and standing height.

*Average sitting height for quarter year periods.*—In 16 quarter year periods Group S excelled in average sitting height; in 22 quarter year periods Group P excelled; in 10 periods no comparison could be made.

#### WEIGHTS.

Weights were obtained for 768 boys, of whom 593 belonged in Group S, 114 in Group P, and 61 in Group U.

The curve (chart 1) in weights is less uniform from 6 to 9 than from 9 to 15; at 16 there is a sudden and very marked decrease of the

increase similar to the decrease of the increase in height and weight in girls at 14; at 15 and at 17 the increase is striking.

*Average weights for total year periods.*—In 6 total year periods (namely, 7, 10, 11, 12, 15, and 16 years), the average weight in Group S excelled that of Group P, and in 6 total year periods (namely, 6, 8, 9, 13, 14, and 17 years) the average in Group P excelled that of Group S. Some of the differences are very slight, and the conclusion appears to be that the boys of Groups P and S showed no essential differences in average weight.

*Average weights for quarter year periods.*—In 20 quarterly periods the average weight of Group S exceeded that of Group P; in 18 periods the average weight of Group P exceeded that of Group S; and in 10 periods no comparisons could be made.

#### White Girls.

##### STANDING HEIGHTS.

Of 1,259 girls, standing heights were obtained for 881, of whom 666 belonged to Group S, 177 to Group P, and 38 to Group U.

The increase is fairly uniform, year by year, up to the period at 14, when there is a very marked decrease of the increase; from 15 to 17 the increase is much less than prior to 13.

*Average standing height for total year periods.*—In 9 total year groups (namely, 7, 8, 9, 10, 11, 12, 13, 15, and 16 years) the average standing height of Group S excelled that of Group P, and in 3 total year periods (namely, 6, 14, and 17 years) the average standing height of Group P excelled that of Group S.

*Average standing height for quarter year periods.*—In 32 quarter year periods the average height of Group S exceeded that of Group P; in 12 periods the average height in Group P exceeded that of Group S; and in 4 periods no comparison could be made.

##### SITTING HEIGHTS.

Sitting heights were obtained for 879 girls, 665 of whom belong to Group S, 176 to Group P, and 38 to Group U.

There is a decrease of the increase at 11, less marked than, but corresponding to, the decrease of the increase in the boys for the same period; there is a sudden and very marked decrease of the increase at 14, corresponding to and nearly paralleling the decrease of the increase in the standing height of the girls for the same period; from 14 to 17 the increase is less marked and less uniform than that of the boys for the same period and out of all proportion to the increase in standing height for the girls for the same period.

*Average sitting heights for total year periods.*—In 8 total year periods (namely, 6, 8, 10, 11, 13, 15, 16, and 17 years), the average sitting

height of Group S exceeded that of Group P and in 4 periods (namely, 7, 9, 12, and 14 years), the average sitting height for Group P exceeded that of Group S.

*Average sitting height for quarter-year periods.*—In 30 periods the average sitting height of Group S exceeded that of Group P; in 12 periods the average sitting height of Group P exceeded that of Group S; in one period the average sitting height was equal in both groups; and for 5 periods no comparison could be made.

#### WEIGHTS.

Weights were obtained for 877 girls, of whom 662 belonged to Group S, 177 in Group P, and 38 in Group U.

The most marked irregularity in the curve is the decrease of the increase at 14, corresponding to the decrease of the increase in sitting and standing height in girls for this same period; at 15 the increase is less marked, and at 16 more marked, than in the boys.

*Average weight for total year periods.*—In 9 total year periods (namely, 8, 9, 10, 11, 13, 14, 15, 16, and 17 years) the average weight in Group S excelled that of Group P and in 3 total year periods (6, 7, and 12 years) the average weight in Group P exceeded that of Group S. It would therefore appear that in the case of the girls the weight development at sewerer homes was better than that at homes provided with a privy, although in some instances the differences were not very marked.

*Average weight for quarter-year periods.*—In 28 periods the average weight in Group S exceeded that of Group P; in 16 periods the average weight of Group P exceeded that of Group S; and in 4 periods no comparison could be made.

#### Comparison of Boys and Girls.

##### STANDING HEIGHT.

On chart 1 it is seen that the girls of 6 years averaged nearly an inch taller than the boys; at 7, 8, and 9 the boys and girls were practically equal, though there was a very slight difference in favor of the boys; at 10 the boys were distinctly taller; from 10 to 13, inclusive, the girls grew more rapidly and exceeded the boys in height for 11, 12, and especially for 13; from 13 to 17, and especially from 14 to 17, the growth of the boys exceeded that of the girls.

*Sudden irregularities in curves.*—The most striking irregularity in the curves is found in the girls at 14; there is a corresponding but less pronounced irregularity in the boys at 14.

There is a perceptible irregularity in the boys' curve at 11, which does not show in the girls.

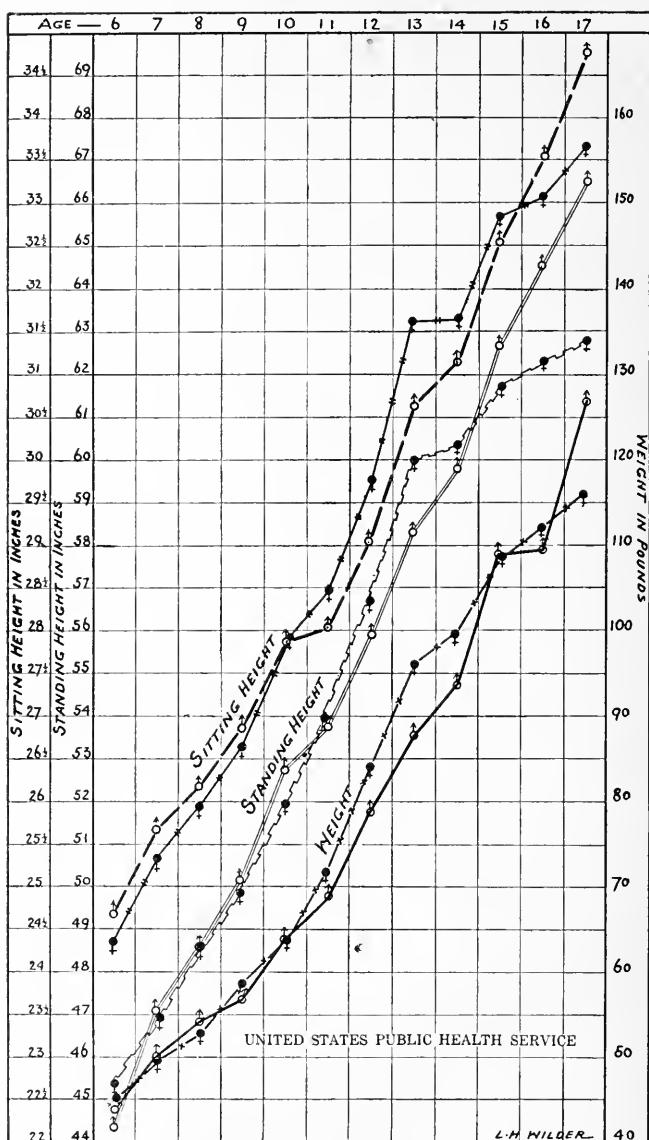


CHART 1.—Average height (standing and sitting) and weight of 1,642 to 1,652 white school children (765 to 771 boys, ♂, 877 to 881 girls, ♀) plotted by total year periods 6 to 17, inclusive. The scale for sitting height is double that for standing height. Height is given in inches, weight in pounds. Prepared from Tables 1 and 2.

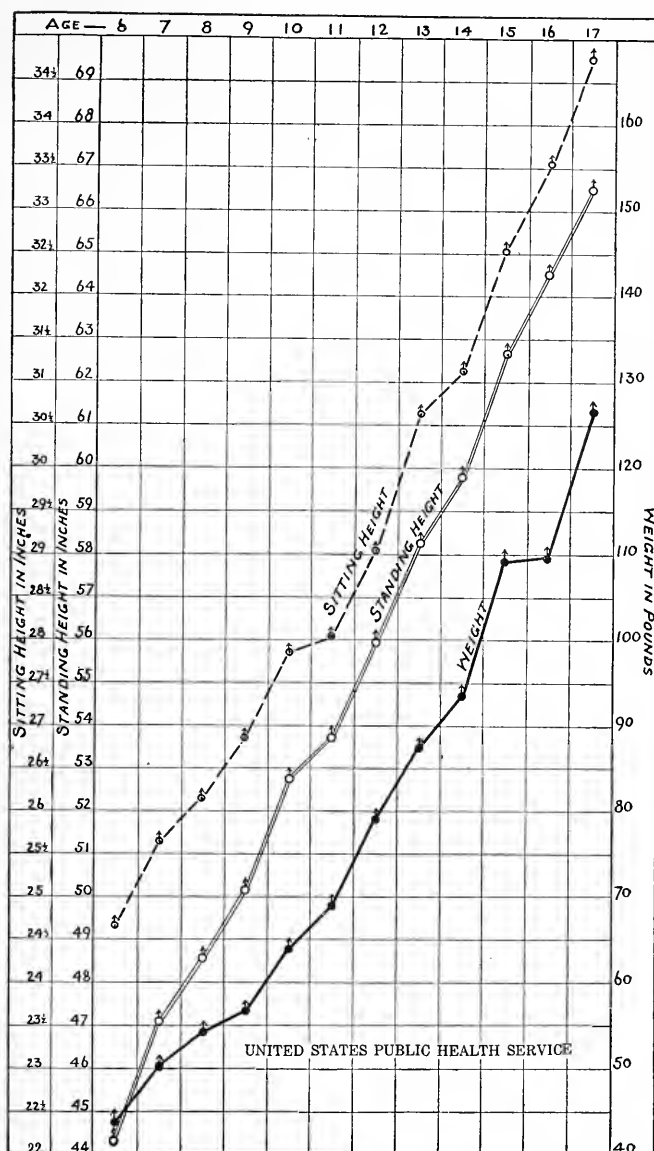


CHART 2.—Average height (standing and sitting) and weight of 765 to 771 white boys plotted by total year periods 6 to 17, inclusive. The scale for sitting height is double that for standing height. Height is given in inches, weight in pounds. Prepared from Table 1.

## SITTING HEIGHT.

In sitting height the boys excelled the girls from 6 to 9 inclusive; at 10 the boys and girls were practically equal, but there was a very slight difference in favor of the girls; following this point, the growth in sitting height of girls was distinctly greater than among boys for 11, 12, and 13, and the girls show a greater sitting height than the boys for these periods; beginning with 13, the boys grew more rapidly and while the girls still had a greater sitting height at 14 and 15, the boys excelled at 16 and 17.

*Sudden irregularities in curves.*—The most pronounced irregularity in curve is shown in girls at 14, when there was almost a total cessation of growth in sitting height; this corresponded to the decrease of the increase in standing height of girls; there was a corresponding but less pronounced decrease of the increase in boys at 14.

At 11 there was a pronounced decrease of the increase in boys, corresponding to the decrease of the increase in standing height of the same boys.

## WEIGHT.

The difference between the boys and girls from 6 to 10 is slight and irregular; from 11 to 14 the girls are heavier than the boys; at 15 they are practically equal; at 16 the girls are heavier, and at 17 the boys are heavier.

*Sudden irregularities in curves.*—There is a marked irregularity in the curve at 14 in the girls, corresponding to the decrease of the increase in sitting and standing height.

There is a perceptible irregularity for boys at 11 corresponding to the decrease of the increase in sitting and standing heights in boys.

The most marked irregularity is in boys at 16, when the increase in weight was almost insignificant.

## Cases of Intestinal Infections.

## STANDING HEIGHTS.

*Necator.*—In 30 cases (23 boys, 7 girls), pupils showing hookworm infection were shorter than the average for their respective groups, and in 21 cases (16 boys, 5 girls), they were above the average.

*Ascaris.*—In 19 cases (16 boys, 3 girls), pupils showing *Ascaris* infection were shorter than the average for their respective groups and in 20 cases (16 boys, 4 girls) they were above the average.

*Trichuris.*—In 11 cases (10 boys, 1 girl), pupils showing whipworm infection, were below the average for their respective groups, and in 4 cases (boys) they were above the average.

*Lambliia.*—In 32 cases (26 boys, 6 girls), pupils showing *Lambliia* infection were below the average for their respective groups, and in 37 cases (30 boys, 7 girls) they were above the average.

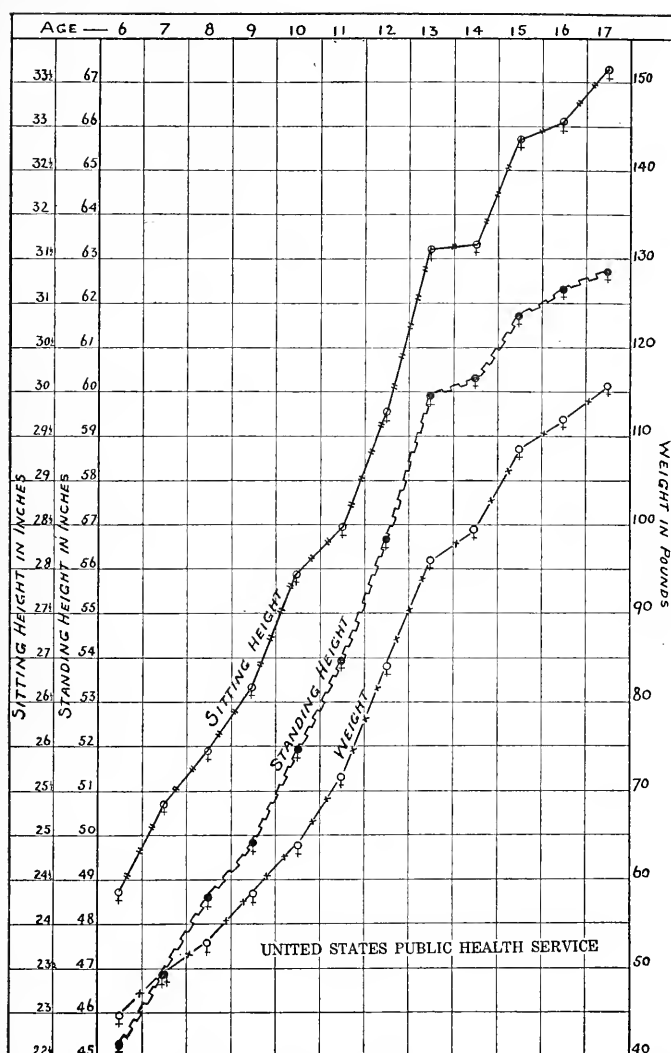


CHART 3.—Average height (standing and sitting) and weight of 877 to 881 white girls, plotted by total year periods 6 to 17 inclusive. The scale for sitting height is double that for standing height. Height is given in inches, weight in pounds. Prepared from Table 2.

*Endamæba coli*.—In 20 cases (17 boys, 3 girls) pupils were below the average for their respective groups, and in 32 cases (22 boys, 10 girls) they were above the average.

*Conclusion*.—It seems apparent that in the case of *Ascaris*, *Lambliæ*, and *Endamæba coli* these figures do not present any evidence of a general retardation in growth.

The figures presented for hookworms, when taken into consideration with general experience with this infection, seem to indicate that even the relatively light infections with which we were dealing may account for a portion of the undersize.

The figures for whipworms are a distinct surprise, for it is difficult to believe that these parasites, especially in such light infections as were present, could be held accountable for the preponderance of subaverage size in so high a percentage of cases.

#### SITTING HEIGHT.

*Necator*: In 35 cases (21 boys, 14 girls), children showing hookworm infection were shorter than the average of their respective groups, and in 25 cases (19 boys, 6 girls) they were above the average.

*Ascaris*: In 20 cases (16 boys, 4 girls), children showing infection with *Ascaris* were shorter than the average of their respective groups, and in 26 cases (22 boys, 4 girls) they were above the average.

*Trichuris*: In 5 cases (4 boys, 1 girl), pupils showing infection with whipworms were shorter than the average of their respective groups, and in 3 cases (boys) they were above the average.

*Lambliæ*: In 35 cases (23 boys, 12 girls), pupils showing infection with *Lambliæ* were shorter than the average of their respective groups, and in 37 cases (30 boys, 7 girls) they were above the average.

*Endamæba coli*: In 29 cases (22 boys, 7 girls), pupils showing infection with *E. coli* were shorter than the average of their respective groups, and in 28 cases (18 boys, 10 girls) they were above the average.

*Conclusion*.—In the case of *Ascaris*, *Lambliæ*, and *Endamæba coli*, no evidence was obtained that these parasites cause a decrease in sitting height in the average case. In hookworm infection, the evidence points to a decrease in sitting height. In whipworm infection the figures are too small to be trustworthy.

#### WEIGHTS.

*Necator*: In 26 cases (18 boys, 8 girls), pupils infected with hookworms weighed less than the average of their respective groups, and in 22 cases (15 boys, 7 girls) they weighed more than the average.

*Ascaris*: In 17 cases (13 boys, 4 girls), pupils infected with *Ascaris* weighed less than the average of their respective groups, and in 25 cases (21 boys, 4 girls) they weighed more than the average.



*Trichuris*: In 5 cases (boys), pupils infected with whipworms weighed less than the average of their respective groups, and in 2 cases (boys) they weighed more than the average.

*Lamblia*: In 33 cases (25 boys, 8 girls) pupils infected with *Lamblia* weighed less than the average of their respective groups, and in 39 cases (28 boys, 11 girls) they weighed more than the average.

*Endamæba coli*: In 27 cases (19 boys, 8 girls), pupils infected with *E. coli* weighed less than the average for their respective groups, and in 29 cases (20 boys, 9 girls) they weighed more than the average.

*Conclusion*.—The evidence available from these data indicates that *Ascaris*, *Endamæba coli*, and *Lamblia* apparently did not act detrimentally upon the weights of the children.

Hookworms may perhaps have been a detrimental factor in weights, but the infections were light and the average detrimental effect was apparently not great.

The whipworm infections are rather few in number to be used as basis for conclusions.

#### General Conclusions and Summary.

The children included in these studies are white school children, nearly all American and southern born, and all attending school in the southern city of X, which is situated in the sandy coastal plain. The results obtained are not to be used as standards for the clay lands or the mountains, nor should they be used as standards for farm children in the sand areas.

The heights and weights were taken for quarter-year periods, and all children of a given quarterly group (as 6.00, 6.25, 6.50, and 6.75) are of the same age *to the day*. There is a slight variation of the date on which these measurements were taken, in some instances, but this rarely, if ever, exceeded 72 hours and therefore may safely be ignored.

All quarter-year groups are summarized into total year groups; for instance, the children of 6.00, 6.25, 6.50, and 6.75 years are summarized into the 6-year group. A comparison between 6 and 7 includes, therefore, all the children from 6.00 to 6.75, inclusive, as compared with all the children from 7.00 to 7.75, inclusive.

Heights (standing and sitting) and weights were taken for 1,642 to 1,652 pupils (765 to 771 boys, 877 to 881 girls) from 6.00 to 17.75, inclusive. In addition to age groups these children are compared by sanitary groups (P, from homes with privy; S, from homes with sewers, but without privies; U, from homes of unknown sanitation).

*Proportion of sitting and standing height*.—In general the sitting height is a little more than one-half of the standing height, but in girls from 13 to 17, inclusive, it is considerably more than one-half of the standing height.

*Interruptions in growth*.—The children showed two rather striking interruptions in growth. At 11 there is a rather striking decrease



of the increase in the standing height, sitting height boys and a less marked decrease of the increase in the sitting height of the girls.

At 14 there is a sudden and very pronounced decrease of the increase in the standing height, sitting height, and weight of girls. In this connection it is rather suggestive that these girls average their first menstruation at 13.2 years of age.

The change in growth of boys at this age is much less striking. At 16 there is a marked interruption in the increase of weight among the boys.

*Comparison of boys and girls.*—In the total year periods 6 to 13 there is no constant and uniform difference in growth between boys and girls; in some of these periods the boys excel and in others the girls excel; but from 13 to 17 the growth of the boys is in general far in excess of that of the girls; this difference is especially marked at 17 years.

*Sanitary groups.*—Of 24 total year periods (12 of boys, 12 of girls) Group S excelled in standing height in 16 periods, Group P in 8 periods; in sitting height, Group S excelled in 13 periods, Group P in 11 periods; in weight, Group S excelled in 15 periods, Group P in 9 periods.

Accordingly, the children from homes with better sanitation excelled in a total of 44 averages, while children from homes with poorer sanitation excelled in 28 averages. In general, therefore, the children who came from the homes with better sanitation excelled those who came from homes with poorer sanitation. It is, however, self-understood that the sanitation, with its results, is only one of the many elements involved in explaining the differences.

*Intestinal infections.*—The figures for whipworm infection are too small to warrant conclusions.

No evidence was found that infection with *Ascaris*, *Lambia*, or *Endamæba coli* had any material effect in retarding growth, but it should be recalled that the *Ascaris* infections were light.

In children showing infection (light or rather light cases) with hookworms, the evidence is not striking, but it summarizes as follows:

	Below average.	Above average.
Standing height.....	30	21
Sitting height.....	35	25
Weight.....	26	22
Total.....	91	68

Thus, in final score, the hookworm cases were below average in 91 markings and above the average in 68 markings. The conclusion appears, therefore, to be justified that, even in the light cases with which we were dealing, the infection had an appreciable effect on heights and weights.



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